

Total No. of Questions : 12]

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[3861]-157

F. E. (Semester - II) Examination - 2010

ENGINEERING MATHEMATICS - II

(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 100

Instructions :

- (1) In section I, solve Q. No. 1 or No. 2, Q. No. 3 or Q. No. 4, Q. No. 5, or Q. No. 6 and In section - II, solve Q. No. 7 or Q. No. 8, Q. No. 9 or Q. No. 10, Q. No. 11 or Q. No. 12.
- (2) Answers to the **two sections** should be written in **separate books**.
- (4) Black figures to the right indicate full marks.
- (5) Assume suitable data, if necessary.

SECTION - I

Q.1) (A) Form the differential equation whose general solution is $Ax^2 + By^2 = 1$ (A, B are arbitrary constants). [05]

(B) Solve : (Any Three) [12]

(a) $(x + y)^2 \left(x \frac{dy}{dx} + y \right) = xy \left(1 + \frac{dy}{dx} \right)$

(b) $(x + 2y - 3) dx - (3x + 6y - 1) dy = 0$

(c) $y \log y dx + (x - \log y) dy = 0$

(d) $\frac{dy}{dx} = -e^{x-y} (e^x + e^y)$

OR

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Q.2) (A) Form the differential equation whose general solution is $y = e^x (c_1 \cos x + c_2 \sin x)$, where c_1, c_2 are arbitrary constants. [05]

(B) Solve : (Any Three) [12]

(a) $(1 + y^2) + (x - e^{-\tan^{-1} x}) \frac{dy}{dx} = 0.$

(b) $(y^2 e^{xy^2} + 4x^3) dx + (2xye^{xy^2} - 3y^2) dy = 0.$

(c) $(x^2y + y^4) dx + (2x^3 + 4xy^3) dy = 0.$

(d) $\cos x \frac{dy}{dx} + y \sin x = \sqrt{y \sec x}.$

Q.3) Attempt any three of the following :

(a) The temperature of water initially is 100°C and that of surrounding is 20°C . If the water cools down to 60°C in first 20 minutes, what will be the time required to fall temperature up to 30°C ? [05]

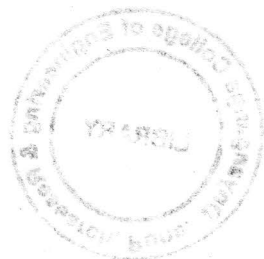
(b) Form the differential equation for the circuit containing a resistance 'R' and a condenser of capacity 'C' in series with emf $E_0 \sin \omega t$. Find current at any instant t.

(Given $i = 0$ at $t = 0$) [06]

(c) For steady heat flow through the wall a hollow sphere of inner and outer radii r_1 and r_2 respectively, the temperature u at a distance r ($r_1 < r < r_2$) from the centre of sphere is given by

$$r \frac{d^2 u}{dr^2} + 2 \frac{du}{dr} = 0.$$

If u_1 and u_2 are the temperatures at inner and outer surfaces respectively. Find u in terms of r . [06]



- (d) A bullet is fired into sand tank, its retardation is proportional to square root of its velocity. Show that the bullet will come to rest in time $\frac{2\sqrt{v}}{k}$, where v is initial velocity. [05]

OR

Q.4) Attempt **any three** of the following :

- (a) Find orthogonal trajectories for the family of parabolas $y^2 = 4ax$. [05]
 (b) A resistance of 100 ohms and an inductance of 0.5H are connected in series with a battery of 20 volts. Find the current in the circuit when initially $i = 0$ at $t = 0$. [05]
 (c) A point executing S.H.M. has velocities v_1 and v_2 and acceleration a_1 and a_2 in two positions respectively. Show that

distance between two positions is $\left| \frac{v_1^2 - v_2^2}{a_1 - a_2} \right|$. [06]

- (d) In a chemical reaction in which two substances A and B initially of amounts a and b respectively are concerned. The velocity of transformation $\frac{dx}{dt}$ at any time t is known to be equal to the product “ $(a - x)(b - x)$ ” of the amounts of the two substances then remaining untransformed. Find t in terms of x if $a = 0.7$, $b = 0.5$ and $x = 0.3$ when $t = 300$ seconds. [06]

Q.5) (A) Obtain Fourier series for

$$f(x) = \begin{cases} \pi x, & 0 \leq x \leq 1 \\ \pi(2 - x), & 1 \leq x \leq 2 \end{cases} \text{ with period } 2. \quad [07]$$

- (B) If $I_n = \int_0^{\pi/4} \frac{\sin(2n-1)x}{\sin x} dx$, then prove that

$$I_{n+1} - I_n = \frac{1}{n} \sin \frac{n\pi}{2} \text{ and hence evaluate } I_3. \quad [05]$$

- (C) Evaluate : $\int_0^{\infty} x^2 e^{-h^2 x^2} dx$. [04]

OR

